United Nations A/AC.105/1106

General Assembly

Distr.: General
5 January 2016

Original: English

Committee on the Peaceful Uses of Outer Space

Activities carried out in 2015 in the framework of the workplan of the International Committee on Global Navigation Satellite Systems

Report of the Secretariat

I. Introduction

1. The International Committee on Global Navigation Satellite Systems (ICG) was established under the umbrella of the United Nations in 2005 as an informal, voluntary forum to discuss all matters regarding global navigation satellite systems (GNSS) on a worldwide basis. The Providers' Forum, established within ICG in 2007, provides a forum for discussing and examining key technical issues and operational concepts concerning compatibility and interoperability among systems. ICG marked its tenth anniversary in 2015, which represented a milestone in Member States' cooperation in the use of outer space for peaceful purposes.

2. ICG and its Providers' Forum hold annual meetings to review and discuss developments relating to GNSS. The annual meetings also address GNSS science and innovative technology applications and the protection of the GNSS spectrum, orbital debris and orbit deconfliction. The tenth meeting of ICG and the fifteenth meeting of the Providers' Forum were held in Boulder, United States of America, from 1 to 6 November 2015 (see A/AC.105/1104). The Department of State and the University Corporation for Atmospheric Research organized the meetings on behalf of the Government of the United States.

3. ICG and its Providers' Forum work to promote the introduction and utilization of GNSS services and their future enhancements, including in developing countries, providing assistance, as necessary, for the integration of GNSS into existing infrastructures. ICG also assists GNSS users with their development plans and applications by encouraging coordination and serving as a focal point for information exchange. Participation in ICG is open to all countries and entities that are either GNSS providers or users of GNSS services and that are interested and willing to actively engage in ICG activities.

V.16-00006 (E) 140116 150116

Please recycle

4. The Office for Outer Space Affairs, in its capacity as the executive secretariat of ICG and its Providers' Forum, organizes regional workshops, training courses and technical seminars focusing on capacity-building in the use of GNSS-related technologies in various rapidly growing fields of science and industry. Those activities bring together a large number of experts every year, including experts from developing countries, to discuss and act on issues that are also of great relevance to ICG.

5. The present report describes the activities undertaken or supported by the Office for Outer Space Affairs during 2015 and their major results. Detailed information on the activities and educational resources are available on the ICG information portal (www.unoosa.org/oosa/en/SAP/gnss/icg.html).

II. Activities of the International Committee on Global Navigation Satellite Systems carried out in 2015

6. Pursuant to the ICG workplan for 2015 and its recommendations, the Office for Outer Space Affairs, in partnership with other international agencies, including the Abdus Salam International Centre for Theoretical Physics and the International Telecommunication Union (ITU), focused on: (a) disseminating information through a network of the information centres hosted by the regional centres for space science and technology education, affiliated to the United Nations; (b) promoting the use of GNSS as tools for scientific applications; and (c) building the capacity of developing countries in using GNSS technology for sustainable development.

A. Information dissemination through a network of the information centres hosted by the regional centres for space science and technology education, affiliated to the United Nations

7. The ICG information centres are hosted by the regional centres for space science and technology education, affiliated to the United Nations. The regional centres are located in India and China for Asia and the Pacific, in Morocco and Nigeria for Africa, in Brazil and Mexico for Latin America and the Caribbean and in Jordan for Western Asia. The centres provide expert support and technical assistance to member countries in enhancing their capabilities in various disciplines of space science and technology that can advance their scientific, economic and social development.

8. The ICG information centres are working towards the establishment of a network of institutions involved or interested in GNSS. They are also identifying new applications that could be developed in the regions on the basis of GNSS services. The centres coordinate their activities closely with ICG and its Providers' Forum through the ICG executive secretariat.

9. In line with the GNSS education curriculum developed by ICG in 2012, Trimble Navigation Ltd. provided educational materials related to Global Positioning System (GPS) to all centres in order to enhance the effectiveness of learning and teaching in the GNSS training courses.

10. A course on space weather and GNSS: ionosphere and Earth's magnetic field was held at the African Regional Centre for Space Science and Technology Education — in French language (CRASTE-LF) in Rabat from 16 to 21 February 2015. The Office for Outer Space Affairs and the Polytechnic School and Laboratory of Physics and Plasma Technologies organized the course in order to introduce data relating to the ground network of GNSS stations, mainly the GPS network, which were made available via the Internet. Studies of the ionosphere and the impact of the sun on the Earth's plasma environment, as well as studies of the troposphere, were presented. The course provided valuable experience for those seeking to initiate space science research programmes in their institutions in order to address all aspects of the response of the mid- and low-latitude ionosphere to magnetic storms and space weather effects using existing data from GPS and GNSS stations in Africa.

11. A total of 28 researchers from nine francophone African countries attended the course, which was co-sponsored by the United States and the European Commission through ICG, CRASTE-LF and the Islamic Educational, Scientific and Cultural Organization.

B. Promoting the use of global navigation satellite system technologies as tools for scientific applications

1. Space weather effects on global navigation satellite systems

12. Ionospheric research is an essential component of the development and implementation of global navigation satellite augmentation systems. A good understanding of the challenges posed by the ionosphere could provide important insights into the development of such systems. This is particularly true at low latitudes, which is where most developing countries lie.

13. Researchers from developing countries are becoming more and more interested in acquiring knowledge of ionospheric effects in view of the possible implementation of satellite-based augmentation systems and ground-based augmentation systems in their countries. A workshop on ionospheric effects on satellite- and ground-based augmentation system applications at low latitudes, held in Trieste, Italy, from 2 to 13 March 2015, was organized in cooperation with the Abdus Salam International Centre for Theoretical Physics, Boston College, the Institute of Navigation of the United States and the European Space Agency, and co-sponsored by the United States and the European Commission through ICG. The aim of the workshop was to promote ionospheric research in low-latitude countries with a view to providing support for the implementation of navigation satellite augmentation systems in those countries.

14. A total of 73 experts, including 19 lecturers and 11 representatives of the Satellite-Based Augmentation System Ionospheric Working Group, participated in the workshop. Funds provided by the United States and the European Commission through ICG were used to defray the costs of air travel for six experts from Brazil, India, Indonesia, Nigeria and Thailand. Detailed information about the workshop is available on the Abdus Salam International Centre for Theoretical Physics website (http://indico.ictp.it/event/a14232/overview).

15. The Office for Outer Space Affairs, in cooperation with the International Union of Radio Science and the Abdus Salam International Centre for Theoretical Physics, organized a special session on ionospheric effects on GNSS systems at low latitudes in conjunction with the first International Union of Radio Science Atlantic Radio Science Conference, held in Gran Canaria, Spain, from 18 to 22 May 2015. The aim of the session was to encourage scientists investigating the effects of ionospheric variability on GNSS to present their most recent findings on the low-latitude effects on GNSS operations. Funds provided by the United States through ICG were used to defray the costs of air travel for three scientists from Ethiopia, India and Kenya. Detailed information about the special session is available on the Conference website (www.at-rasc.com).

16. The Office for Outer Space Affairs and Boston College participated in the fourteenth International Symposium on Equatorial Aeronomy, held in Bahir Dar, Ethiopia, from 19 to 23 October 2015. The Symposium included presentations and hands-on demonstrations of GNSS receivers. It brought together lower atmospheric and ionospheric scientists to share their new findings and develop strategies to tackle potential issues related to the physics of the thermosphere and ionosphere at equatorial, low and middle latitudes. Funds provided by the United States through ICG were used to defray the costs of air travel for five scientists from Africa. Detailed information about the Symposium is available at www.bdu.edu.et/isea14.

17. In accordance with the ICG recommendation concerning the NeQuick ionospheric model, a quick-run ionospheric electron density model, the Abdus Salam International Centre for Theoretical Physics, in cooperation with the Office for Outer Space Affairs and the European Space Agency, organized a workshop on the latest developments and advanced uses of NeQuick, held in Trieste, Italy, from 4 to 8 May 2015. The workshop presented the evolution of the model and its validation methodology, as well as the use of the model for ionospheric studies related to space weather and assessment studies in satellite navigation systems at low latitudes.

18. A total of 46 experts from 24 countries attended the workshop. Funds provided by the United States and the European Commission through ICG were used to defray the costs of air travel for seven scientists from developing countries. Detailed information about the workshop is available on the Abdus Salam International Centre for Theoretical Physics website (http://indico.ictp.it/event/a14235).

2. Reference frames and timing

19. AfricaArray is an educational initiative to support postgraduate studies and promote research into the structural detail of the Earth's crust and mantle. It has produced a number of master's and doctorate degrees in seismology, and one of its goals is to expand seismic networks in Africa.

20. An update on activities and progress made under the initiative during the past year was presented at the tenth AfricaArray workshop, held in Johannesburg, South Africa, from 18 to 26 January 2015 and hosted by the University of the Witwatersrand. The workshop included a scientific meeting on 19 and 20 January 2015 during which African researchers presented their respective projects. Training courses on seismic station operation, GPS data processing and earthquake hazard and risk quantification were also held. Funds provided by the United States through

ICG were used to defray the costs of air travel for 20 experts from Africa. Detailed information about the workshop is available on the AfricaArray website (www.africaarray.psu.edu).

21. In accordance with the ICG recommendation concerning reference frames, the Office for Outer Space Affairs, in cooperation with the International Federation of Surveyors Commission 5, the International Association of Geodesy, the United Nations Initiative on Global Geospatial Information Management for Asia and the Pacific and the Singapore Land Authority organized a technical seminar on vertical reference frames in practice, held in Singapore on 27 and 28 July 2015 in conjunction with the thirteenth South-East Asian Survey Congress. The seminar complemented an earlier seminar, held in the Philippines in 2013, that had focused on 3D frames, and addressed the need for the benefits and applications of a height system and vertical datum transformations. It consisted of five sessions and provided educational materials on the following topics: (a) geometric and physical height systems; (b) time dependence and transformations; (c) GNSS heighting and applications; and (d) airborne gravity for an improved vertical datum and the contribution of GNSS receiver manufacturers to vertical reference frames.

22. A total of 22 experts, representing a mix of academic and government institutions and industry from around the world, participated in the seminar. Funds provided by the United States through ICG were used to defray the costs of air travel for five experts.

C. Building the capacity of developing countries in using global navigation satellite system technology for sustainable development

1. Regional workshop on global navigation satellite system applications

23. The United Nations/Russian Federation workshop on the applications of global navigation satellite systems was organized by the Office for Outer Space Affairs, in cooperation with the Russian Federal Space Agency (Roscosmos), on behalf of the Government of the Russian Federation. The workshop was hosted by the joint stock company Academician M.F. Reshetnev Information Satellite Systems (JSC ISS) in Krasnoyarsk, Russian Federation, from 18 to 22 May 2015 (see A/AC.105/1098). The main objectives of the workshop were to strengthen regional information and data exchange networks on the use of GNSS technology, including various training programmes and capacity-building needs in GNSS and its applications, and to develop a regional plan of action that would contribute to the wider use of multi-constellation GNSS.

24. The workshop provided a unique opportunity to channel support for the further use of GNSS technology in various domains, such as aviation, maritime transportation, communications, timing, science and agriculture. The recommendations and observations put forward by the participants in the workshop provided guidance on how institutions could work together through regional partnerships. The Office for Outer Space Affairs should provide support for the consolidation of the partnerships that were formed at the workshop. Those partnerships will result in the sharing and transfer of knowledge and the development of joint activities and project proposals. In addition, the Office should

work further towards ensuring that end users will benefit in many ways from accurate and reliable positioning services.

2. Expert meeting on global navigation satellite system services

25. An ICG expert meeting on global navigation satellite services, held in Vienna from 15 to 18 December 2015, focused on identifying the needs of users with respect to the compatibility and interoperability of global and regional systems, and space-based augmentations providing and planning to provide GNSS services. The aim of the meeting was to increase knowledge and expertise relating to GNSS capabilities and their benefits to GNSS users worldwide.

26. With more than 75 participants, the meeting was a fitting way to mark the tenth anniversary of ICG. Looking to the future, much of the discussion focused on the exchange of updated information on utilizing GNSS services for a range of commercial, scientific and technological applications. Specific areas of interest included new services and capabilities, timing and geodetic reference frames, education and training, and global applications, including space weather effects. The meeting also addressed challenges that might be faced in a multi-GNSS service.

27. Introductory and welcoming statements were made by the Director of the Office for Outer Space Affairs and representatives of the United States and the European Commission, as co-sponsors of the meeting. The speakers highlighted that the growing need to locate objects accurately and reliably had wide-ranging implications for the environment, disaster warning and emergency response, among other things. ICG and the Office for Outer Space Affairs were working to raise awareness of the important role of GNSS in societies and to promote international collaboration in the field.

28. A total of 30 presentations were made by invited speakers from both developing and developed nations during the four thematic sessions, which were focused on the following topics: precise positioning and GNSS reference station networks; space weather and GNSS; applications of GNSS; regional and national initiatives and experiences; and capacity-building. In addition, two discussion panels enabled further deliberation on the main topics and led to the development of a common strategy aimed at increasing the use of GNSS technology and contributing to the level of cooperation, including possible collaboration with industry leaders and linkages with current and planned system and augmentation system providers.

29. A technical seminar on GNSS spectrum protection and interference detection and mitigation was organized during the expert meeting on 16 and 17 December 2015. The experts who gave presentations included representatives of Australia, Japan, the United States, the European Union and ITU. The purpose of the seminar was to highlight the importance of GNSS spectrum protection at the national level and explain how to reap the benefits of GNSS.

30. The seminar included an introduction to how GNSS works as a system, during which experts discussed the history of GNSS, various system signals, receiver fundamentals, why the signal is weak compared with terrestrial systems and the three ways in which interference affects GNSS. A key point of discussion was the fact that GNSS signals were very weak (in the order of -158 dBW) by the time they arrived on Earth. GNSS signals were thus very susceptible to interference, whether

intentional or unintentional. Countries therefore needed to manage and protect the spectrum allocated for GNSS should they plan to use it.

31. Experts then explained why spectrum management was necessary and how it was implemented within national and international frameworks. Presentations were made on ITU spectrum management responsibilities and World Radiocommunication Conference outcomes related to GNSS. It was noted that the World Radiocommunication Conference, which was held every four years, provided a forum for States to propose changes or new additions to the spectrum allocations listed in the Radio Regulations. Examples of how national spectrum agencies in Japan, the United States and the European Union managed the spectrum at the national level based on the ITU provisions were outlined. In general, national frequency allocations and protections were aligned with the ITU table of frequency allocations. However, they were not necessarily identical, because each State had the sovereign right to manage its own spectrum as long as it did not violate the ITU treaty. The experts concluded with a discussion of other possible non-GNSS emissions present in the GNSS frequency bands, namely radio service emissions, industrial, scientific and medical emissions, and short-range radio device emissions.

32. The seminar continued with presentations on spectrum protection and what nations could do to ensure access to GNSS. The purpose of spectrum protection was to keep the GNSS spectrum clean by ensuring that the frequencies near GNSS were free from licensed, unlicensed and illegal transmissions that interfered with GNSS reception, thereby minimizing signal errors and maximizing the performance of GNSS receivers to include more reliable positioning and timing, faster time to first fix and better tracking within a challenging environment. It was emphasized that only continuous synergistic interactions by all sectors of the terrestrial and satellite communities could ensure that interference in GNSS was limited. Updated information on current efforts and recommendations by ICG with regard to spectrum protection and interference detection and mitigation was also provided.

33. The seminar concluded with a discussion of interference detection and mitigation, which began with a presentation on how GNSS jammers work, with examples of when they were used and the problems that they caused. An overview of regulations to deter the use of jammers in Australia, Canada and the United States was presented. The legality of exporting, importing, selling, using and purchasing jammers in several States was summarized. It was recommended that States enhance education on and institute strict penalties for the use of jammers.

34. Throughout the seminar there were several question-and-answer sessions. The seminar fulfilled its purpose of educating participants on the importance of GNSS spectrum protection and challenged them to engage with their respective national spectrum agencies to ensure continued access to GNSS benefits. Detailed information is available on the website of the Office for Outer Space Affairs (www.unoosa.org/oosa/en/ourwork/icg/activities.html).

III. Technical advisory services

35. To present the work of the Office for Outer Space Affairs, in its capacity as the ICG executive secretariat, and its programme on GNSS applications, as well as the future role of ICG in a multi-constellation GNSS, and to receive feedback from a

diverse GNSS community, the Office participated in and contributed to the following international conferences and symposiums:

(a) Tenth Ilan Ramon Space Conference, held in Herzliya, Israel, on 28 and 29 January 2015;

(b) Munich Satellite Navigation Summit 2015, held in Munich, Germany, from 24 to 26 March 2015;

(c) Space Weather Workshop 2015, held in Boulder, United States, from 14 to 17 April 2015;

(d) Ninth Annual Baška GNSS Conference, held in Baška, Croatia, from 10 to 12 May 2015;

(e) Twenty-eighth International Technical Meeting of the Satellite Division of the Institute of Navigation, held in Tampa, United States, from 14 to 18 September 2015;

(f) International Association of Institutes of Navigation World Congress 2015, held in Prague from 20 to 23 October 2015.

36. The Office for Outer Space Affairs organized two preparatory meetings for the tenth meeting of ICG, chaired by the United States, held in Vienna on 9 February 2015 and on 9 June 2015. Those preparatory meetings were held on the margins of the fifty-second session of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space and the fifty-eighth session of the Committee. At the meetings, it was emphasized that the ICG working groups were playing a key role in the implementation of the workplan of ICG and its Providers' Forum. The fourteenth meeting of the Providers' Forum, held in Vienna on 8 June 2015 and co-chaired by the United States and the European Commission, focused on issues related to open service information dissemination and service performance monitoring, as well as spectrum protection.

37. The Office for Outer Space Affairs also organized the interim meetings of the ICG working groups that formed the basis for views and recommendations on spectrum protection, open service performance and the monitoring of open services, as well as reviewing existing user position integrity concepts for further action. The following intersessional meetings and workshops were organized in 2015:

(a) Fourth workshop on GNSS spectrum protection and interference detection and mitigation, held in Vienna on 10 and 11 June 2015. The workshop continued discussions on recommendations of the previous workshops related to unintentional interference levels, standards for crowdsourcing interference detection, the issues of GNSS as international critical infrastructure and practical aspects of the evaluation of the interference environment in the GNSS frequency bands;

(b) Meeting of the Working Group on Systems, Signals and Services, held in Vienna on 11 and 12 June 2015. The Working Group continued its development of a template that each individual GNSS provider might consider using in its publication of signal and system information, the policies of provision and the minimum levels of performance offered for open services;

(c) Meeting of the subgroup on applications of the Working Group on Enhancement of GNSS Performance, New Services and Capabilities, held in Vienna on 10 June 2015. The meeting focused on how to collect and collate GNSS user requirements in order to quantify a range for the user needs per application domain;

(d) Meeting of the Working Group on Information Dissemination and Capacity-building, held in Vienna on 18 December 2015. The Working Group reviewed progress made in the implementation of and follow-up to its recommendations on space weather education, including the use of space weather instruments for scientific research and for space weather effects on GNSS.

IV. Voluntary contributions

38. The activities of ICG in 2015 were successfully implemented thanks to the support and voluntary contributions (financial and in-kind) of member States:

(a) The Government of the United States provided $265,000 to support capacity-building and technical advisory services and arranged for experts to make technical presentations and participate in discussions during activities described in the present report;

(b) The Government of the United States also provided a sponsorship for two staff members of the Office for Outer Space Affairs to participate in and contribute to the tenth meeting of ICG and its planning meetings;

(c) The European Union provided €100,000 to support capacity-building and technical advisory services and arranged for experts to make technical presentations and participate in discussions during activities described in the present report;

(d) The Government of Japan, the Government of the Russian Federation and the European Space Agency provided sponsorships for experts to make technical presentations and participate in the activities carried out in the framework of the GNSS priority thematic area of the United Nations Programme on Space Applications.